

TROMBIDIID LARVAE IN NEW GUINEA (ACARINA: TROMBIDIIDAE).

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(Forty Text-figures.)

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Owing to the writer's lack of experience, some confusion has arisen with regard to the nomenclature of these species. Shortly after this article was despatched for publication, a paper discussing the relation of these species to endemic typhus in New Guinea was prepared; it included a list (but no descriptions) of the names originally intended for them. The latter article has already been published (1938), and the original names have therefore become *nomina nuda*. A list of the present names with the corresponding original *nomina nuda* is given below:

Present names.	<i>Nomina nuda.</i>
<i>T. hirsti</i> var. <i>buloloensis</i> .	<i>T. hirsti</i> var. <i>morobensis</i> .
<i>T. riot</i> .	<i>T. edwardsi</i> .
<i>N. yeomansi</i> .	<i>N. jamesi</i> .
<i>N. kallipygos</i> .	<i>N. callipygea</i> .
<i>N. impar</i> .	<i>N. clauda</i> .
<i>N. lorius</i> .	<i>N. jimungi</i> .
<i>N. edwardsi</i> .	<i>N. riot</i> .
<i>N. retrocineta</i> .	<i>N. retrocoronata</i> .
<i>N. backhousei</i> .	<i>N. fourrieri</i> .
<i>N. dubia</i> .	<i>N. incerta</i> .
<i>S. jamesi</i> .	<i>S. rotunda</i> .
<i>S. blestowei</i> .	<i>S. yeomansi</i> .
<i>W. morobensis</i> .	<i>W. buloloensis</i> .
<i>L. australiense</i> .	<i>H. blestowei</i> .

General Considerations.

Larval mites are abundant in New Guinea, where they go by the "pidgin" name of *bush-mokka*, and few whites who get off the beaten track escape the irritation of their bites. Natives occasionally complain of their attacks; the Finschhafen tribes call them *pipi*; on the Rai Coast they are called *gugung*. Patton (1931) states that "in New Guinea they are known as *akran*".

The *mokka* is distinctly regional in its habitat. In general, the *kunai* hills (switchback country covered with *kunai* grass and kangaroo grass) are practically free, although the scrub along the water-courses among these hills is fairly heavily infested; the bush is patchy—areas of dense damp jungle in the river basins and smaller valleys are very bad; sago-palm (*sak-sak*) and water-bamboo (*pit-pit*) swamps are reputed to be the most heavily infested spots of all, but the drier, less dense bush on the mountain slopes seems often to be quite free.

The larvae attack the parts of the body where the clothing exerts pressure—around the waistline, beneath the stocking, especially on the dorsum of the foot

and under the garter; on the scrotum, and in the groins and armpits. They bury the full length of their cheliceral fangs in the skin; projecting from between the fangs is found a tubule. In colonies composed of newly-hatched larvae, these tubules appear with rounded blind ends, without any adventitia, of varying lengths from a few microns up. The tubule is a remarkable organ; its wall is thin and colourless, and I have seen one 290μ long. It must be possessed of power to cause lysis of the host's tissues at its tip, probably by reason of a salivary secretion. That there is an irritant secretion injected by the larva is proved by the development, at the site of a bite, of an itching papule topped by a blister.

If such be the case, then the obvious adventitious coat surrounding the fine tubular sheath is easily explained as a zone of reaction by the host's tissues against the irritation of the lysing secretion.

Brandis, in 1897, as quoted by Warburton (1928), described "long trumpet-like organs plunged deeply into the tissues". Fantham, Stephens and Theobald (1916) give two illustrations showing the chelicerae, the tubule and the adventitious coat, with the captions: "1. *Leptus autumnalis* with so-called sucking proboscis (enlarged)" and "2. Do. The so-called proboscis is formed around the hypopharynx sunk into the skin." In the text the following passage occurs: "Around the point attacked there arises a wheal about the size of a lentil, and around the inserted hypopharynx a fibrinous secretion, the 'proboscis', which however is a product of the host just as chitinous secretions are provoked by *Trombidia* parasitic on arthropods."

It seems that my "tubular sheath" and the "long trumpet-like organs" of Brandis are identical with the "hypopharynx" of these writers, and I believe that their name is the best one. It is also apparent that my "adventitious coat" is their "fibrinous secretion", and that it is to the description of this structure as a "proboscis" that they object so strongly. Unless this interpretation of their remarks be accepted, they must be credited with applying the term "hypopharynx" to the chelicerae, which is unlikely.

Womersley (1936a) gives a sketch of *T. macropus* showing the "rostral tube", which corresponds to the hypopharynx.

Hosts.

The following birds and mammals have been found by me to harbour larval mites of various species:

1. Red bush-fowl, Jungle-fowl (*Megapodius duperreyi*). Colonies on neck and legs. Single specimens embedded in the neck, around the eyes, ears and beak, beneath the wings and on the legs, and around the cloaca. Single specimens running free among the feathers. The following species have been found on this bird: *T. hirsti* var. *buloloensis*, *N. yeomansi*, *N. retocincta*, *S. jamesi*, *T. rioi*, *N. edwardsi*, *N. backhousei*, *S. blestowei*. Found on 86 of 93 examined.
2. Grey bush-turkey (*Talegallus jobiensis*). Colonies on comb and wattles. Single specimens as on the bush-fowl. *T. hirsti* var. *buloloensis* was found on 9 of 10 examined.
3. Cassowary, *Muruk* (*Casuarus casuarinus*). Colonies and single specimens as on the bush-fowl. *T. hirsti* var. *buloloensis* was found on 10 examined; a single specimen of *Leeuwenhoekia australiense* Hirst, 1929, was found on one.

4. Ground-pigeon (*Gallicolumba jobiensis*).
Colonies and single specimens as on the bush-fowl. *T. hirsti* var. *buloloensis* was found on 6 of 7 examined.
5. Swamp-hen, Purple water-hen (*Porphyrio melanotus*).
One specimen of *T. hirsti* var. *buloloensis* embedded near the eye on each of 2 of 4 examined.
6. Rail, Swamp-hen (*Amaurornis moluccanus nigrifrons*).
One specimen of *T. hirsti* var. *morobensis* embedded near the cloaca on 1 of 3 examined.
7. Parrot (*Lorius roratus* subsp.).
One colony containing 12 specimens of *N. lorius* on the neck of 1 female of 6 examined.
8. Brown's rat, Little rat (*Rattus browni*).
Many specimens of *N. kallipygos* embedded around the mammae or in the penis of 6, and running free in the fur of 20; ova containing *N. kallipygos* cemented to the abdominal hairs of many. Four specimens of *W. morobensis* running free in the fur of 2. Found on 22 of 300 examined. Brown's rat readily becomes domesticated; of the 300, at least 250 were taken in and around townships, and only 2 carried mites. The remainder were trapped in the bush.)
9. Brown bush rat, Mottle-tailed rat (*Rattus ringens*).
N. impar in rows like fringes along the free margins of the ears, and single specimens on the penis, scrotum, or mammae. Many specimens of *N. kallipygos* on the penis, abdomen, and hind legs, and running free in the fur. Ova containing *N. kallipygos* cemented to the abdominal hairs. Several specimens of *W. morobensis* embedded in the nose. Found on 13 specimens examined.
10. Arboreal "mouse" (*Melomys* sp.).
Single specimens of *N. kallipygos* running free in the fur of 1 of 2 juveniles examined.
11. Arboreal rat, Monckton's melomys (*Melomys moncktoni*).
N. impar in rows on the free margins of the ears. *N. kallipygos* running free in the fur, and embedded in the penis, legs, and scrotum, on 2 examined.
12. Arboreal rat, Stalker's melomys (*Melomys stalker*).
N. impar and *N. kallipygos* as for *M. moncktoni*. Ova containing *N. kallipygos* cemented to the abdominal hairs. Found on 1 only.
13. Arboreal rat, Rufous melomys (*Melomys rubex*).
As for *M. stalker*. Found on 1 examined.
14. Bandicoot, *Mumut* (*Echymipera cockerelli*).
Colonies on the scrotum, or around and just inside the lip of the pouch. The following were found on 9 of 10 examined: *T. hirsti* var. *buloloensis*, *N. kallipygos*, *S. jamesi*, *N. edwardsi*, *N. impar*.
15. Bandicoot, *Mumut* (*Peroryctes raffrayana*).
Colonies of *N. impar* and single specimens of *N. kallipygos* on the scrotum of 1 examined.
16. Bush pig, Wild pig (*Sus papuensis*).
Colonies in the groin and around the ear, on 1 juvenile of 54 examined; 80 specimens of *T. hirsti* var. *buloloensis*.
17. Man.
Nineteen specimens of *T. hirsti* var. *buloloensis* from 3 men at Bulolo; 15 specimens of *S. blestowei* from 2 others at Wewak, and 6 specimens of *S. blestowei* from 1 at Bulolo.

The "colonies" referred to occur on areas of skin which are almost bare of fur or feathers. They are formed of groups of up to 50 larvae, packed closely together, heads down, in hollowed-out pits in the skin. Abandoned pits can be found on birds, filled with a waxy yellow scab which can easily be detached, leaving the pit lined by apparently normal epithelium. Sometimes pits are found surrounding the contour-feathers, but I have never found them around the larger feathers. On the bandicoot, the pits are not deep, and when abandoned are covered with an ordinary serous scab. I have not found on rodents here any colonies or single specimens or abandoned pits, either in or around the ears, except for the fringes of *N. impar* along the free margins of the ears of the various species of *Melomys* and the brown bush-rat.

N. kallipygos and *W. morobensis* do not occur in colonies, but they do occur consistently in fairly large numbers in the same sites on their hosts. *T. rioti*, *N. edwardsi*, *N. retrocineta*, *N. backhousei*, *N. dubia*, and *S. jamesi*, have not yet been found in colonies, which suggests that the chief hosts of these species have not yet been located. These may yet be found among the two species of snipe and one of quail, which have not yet been investigated.

The following have been examined without finding any larval mites whatever; the larger numbers are approximate only, but are practically correct; 100 pigeons (3 species); 80 cockatoos; 20 doves (2 species); 10 parrakeets (2 species); 6 kingfishers; 6 owls (3 species); 3 hawks; 3 hornbills; 2 night-herons; 2 quail; 200 miscellaneous small perching birds (about 30 species); 50 snakes and lizards; 40 flying foxes; 10 bats (3 species); 5 opossums; 3 flying squirrels; 6 wallabies.

Reliable natives, however, assure me that larvae sometimes occur in colonies on wallabies; Womersley (1936a) records *T. macropus* from a wallaby at Darwin.

It will be seen that larval mites have been found on none of the tree- or bush-frequenting birds except a parrot (No. 7 above; this species has never been observed upon the ground; it nests in hollow branches), but on all the available ground-birds except the quail, which lives in the *kunai* and is hard to come by, and the snipe, no specimens of which have as yet been taken. A similar distinction can be drawn among the mammals: all the species of *melomys*, although they build their nests in bushes, nevertheless spend the night foraging on the ground.

I have not found mites on dogs, cats, or domestic fowls.

Technique and Notes.

When collecting specimens from man, it is necessary to examine the selected sites before the evening bath; it is also necessary as a rule to dig them out of the skin with a needle, and it is difficult to avoid damaging them.

Specimens embedded in the skin of game are best secured by cutting out the section of skin and placing it overnight in a small white pot with a screw-on lid. By morning most of the larvae will have detached themselves, and can easily be lifted with a needle. Unless the lid fits perfectly, it is necessary to smear the thread with vaseline to prevent the larvae escaping.

To secure those running free the host should be held over a large sheet of white paper and wiped lightly all over with a piece of cotton wool moistened with chloroform. The fur is then thoroughly brushed and combed, the debris spread on slides, and systematically examined under the microscope, using the low power; this is necessary as many of the specimens from mammals are not orange or red, but cream or pale dirty yellow, and cannot be picked out easily.

They should be mounted in gum-chloral (on the advice of Mr. Womersley; mine until now have been mounted without preparation in "Euparal").

In freshly-killed specimens which are examined at once the eyes are seen to be underlain by a dense accumulation of ruby-red granules or droplets which outline the ocular shields. Much of the body-colour may also be seen to be due to red droplets lying just beneath the body wall; by screwing down the lens on to the coverslip, this fluid can be made to run about. Most of the body-colour fades and disappears; in about 24 hours that under the ocular shields fades through orange and yellow to a weak fluorescent green, and in many specimens becomes indistinguishable after a few days. The eyes themselves are clear and colourless. In several instances I missed a second eye in older mounts, and I owe it to Mr. Womersley that I am able to report the eyes correctly.

It is an important fact that for any given species the size and shape of the scutum and the relative positions of the scutal setae and the pseudostigmata do not vary; these are the only absolute criteria, since appendages may be missing, various relationships alter with the degree of engorgement, and certain features fade shortly after death. It is granted that these criteria may not suffice for complete identification of a specimen, but they are essential for grouping a series so that a full description may be pieced together.

Various decisions made by Gater (1932) on such points as the spelling of *Trombicula* and the retention of Ewing's amended definitions (1929) of the genera *Schöngastia* and *Neoschöngastia* have been followed in this paper, which is modelled to the best of my ability on Gater's work on the Malayan species.

The species here described have been taken at all seasons during the last five years, from hosts from the main Lower Bulolo River basin, in the Morobe



Fig. 1.—Map of the eastern part of New Guinea, showing localities mentioned in text.

District of New Guinea, at a mean altitude of 2,500 feet; *S. blestowei* was also collected on the Suein River, on the coast near Wewak, in the Sepik District (see Fig. 1).

Type specimens of all species here described are at the School of Public Health and Tropical Medicine, University of Sydney, and paratypes of all except *N. retrocineta* and *N. dubia* are at the Australian Museum, Sydney.

All measurements are average figures from as large a number of specimens as possible, up to 25 in some cases, but usually from 4 to 10. Measurements are as follows:

Length of body: from anterior to posterior margins, not including the cephalothorax.

Width of body: greatest width.

Length of legs: exclusive of coxae and tarsal claws.

Scutum: greatest length and width.

Pseudostigmata: distance between centres.

Eyes and scutum: distance between adjacent margins.

The following abbreviations have been used: L, length; W, width; AM, anteromedian; AL, anterolateral (-s); PL, posterolateral (-s) (AM, AL, and PL refer to the scutal setae).

Roman numerals refer either to the segments of the palpi or to the fore-, mid-, and hind-legs, or to the coxae or tarsi of these legs, according to the context.

Photomicrographs were taken with a "Brownie" camera, using a technique described by me elsewhere (1937), and drawings made from these or from freehand sketches direct from the microscope.

Genus *TROMBICULA* Berlese. (*Redia*, ii, fasc. 2, 1905, 155.)

TROMBICULA HIRSTI var. *BULOLOENSIS*, n. var. Figs. 2, 3, 5.

Body: Newly-hatched, a short broad oval, flattened at the posterior end; greatest width between coxae ii and iii. Half-grown, ovoid, widest at level of coxa iii, tapering to half that width posteriorly, the posterior pole flattened or incavated. Fully-engorged, a swollen blunt-ended oval, widest at level of coxa iii. Striations strong; pitting on scutum, maxilla and coxae. Colour bright orange, except those from the bandicoot, which are pale orange, and have not the chelicerae and palpal claws so deeply pigmented. All setae, except those on the cheliceral sheaths and the pseudostigmatic organs, are bright orange. Newly-hatched, L, 176 μ ; W, 147 μ ; fully-engorged, L, 450 μ ; W, 364 μ ; largest seen, 480 μ \times 390 μ . Maxillary setae single, fine, curved, with long branches on the convex side. Chelicerae stout and slightly curved. Dorsoapical tooth single, small and blunt. Ventral tooth small and sharp. Bases of chelicerae deep orange, even in faded specimens. A long, straight, slender nude seta on each cheliceral sheath. Palpi angular, relatively large, projecting boldly forward. One long curved seta with long fine branches on the convex side, on ii; one straight nude seta on iii; on iv, near the base, one curved seta with fine branches on its convex side, and near the apex, two nude setae, one short and stout, the other long and fine. Appendiculum tapering bluntly, with six setae: two very long, coarse and pigmented, with long branches on all sides over the whole length; four finer, with branches on the distal half of the convex side; and one short, nude, near the base. Palpal claw bifurcate, the ventral element shorter but stouter than the dorsal; both strongly curved, with sharp points, and the central core deeply pigmented. Scutum trapezoidal, half as wide again as long; L, 66 μ ; W, 102 μ . Set well forward on the body. Anterior margin slightly concave in its middle three-

fifths, the lateral fifths convex; anterior corners rounded; lateral margins straight or slightly incavated opposite the ocular shields; posterior margin strongly convex, but flattened or smoothly concave in the middle fifth, and curving forward in the lateral fifths to meet the lateral margins; posterior corners about one-fourth of the distance forward, and rounded. Scutal setae 5: stout, tapering bluntly, covered with short spines over the whole surface. The AL set back from the anterior corners and in line with the AM; the PL set well forward in the posterior corners; the four lateral setae set on the edge of the scutum. AM, 47μ ; AL, 50μ ; PL, 56μ . Pseudostigmata one-third of the way back, behind the midpoint of the line joining the AM and PL setae; 45μ apart. Pseudostigmatic organs filiform, very fine, with about 6 fine branches on the convex side of the distal third; L, 56μ . Ocular shield about 7.5μ from the scutum in the fully-engorged larva; closer in the newly-hatched. Eyes double, the anterior much the larger, opposite the pseudostigmata; the posterior just behind the PL setae. Body setae 38: of two forms—those of the



Figs. 2-7.—2. Composite dorsal and ventral diagram of *Trombicula hirsti* v. *buloloensis*, n. var.; 3. Cheliceral fang of *T. hirsti* v. *buloloensis*; 4. Same of *T. rioi*, n. sp.; 5. Dorsal scutum of *T. hirsti* v. *buloloensis*; 6. Same of *T. rioi*; 7. Composite dorsal and ventral diagram of *T. rioi*.

dorsum and the last two rows of the venter are covered all over with fine short branches; the remainder of those of the venter have closely-set short branches on the convex side only. Dorsum: Setae 22, in rows approximately as follows: 2, 6, 6, 4, 2. Row 2 is set close to the posterior margin of the scutum; row 6 is along the posterior margin of the body. Venter: Setae 16, in rows as follows: 2, 2, 6, 2, /2, 2. Legs relatively long. i, 236μ ; ii, 206μ ; iii, 241μ . Leg setae stout, with very short branches on the convex side. Coxal setae single, fine, curved, with long fine branches on the convex side. A similar seta, but coarser and pigmented, on each second segment. Base of sixth segment moderately constricted; distal half of sixth segment of i moderately expanded. All tarsi tapering, that of iii very long and slender. A short stout spur on tarsi i and ii, a long nude seta on tarsus iii.

Nineteen specimens from three men; fifty from seven bandicoots (*Echymipera cockerelli*); many hundreds from many bush-fowl (*Megapodius duperreyi*), bush-turkeys (*Talegallus jobiensis*), Cassowaries (*Casuarus casuaris*) and Ground-

pigeons (*Gallicolumba jobiensis*); one from a rail (*Amaurornis moluccanus nigri-frons*) and two from a Swamp-hen (*Porphyrio melanotus*); eighty from a Bush-pig (*Sus papuensis*).

T. hirsti var. *buloloensis* corresponds very closely with Sambon's description of *T. hirsti* (1927); the differences are:

<i>T. hirsti.</i>	<i>T. hirsti</i> var. <i>buloloensis.</i>
Seta on 2nd palpal segment has 3 branches.	Many branches.
2 nude setae on fourth palpal segment.	2 nude, 1 branched.
Appendicular setae, 6 plain, 1 branched.	1 plain, 5 branched.
Dorsal setae 2, 6, 6, 2, 2, 2.	2, 6, 6, 4, 2.
40 μ long.	56 μ long.
Scutum uniformly smaller.	Larger.

It differs from Hirst's description of *T. akamushi* as quoted by Patton and Evans (1929) as follows:

<i>T. akamushi.</i>	<i>T. hirsti</i> var. <i>buloloensis.</i>
Anteromedian scutal seta longer than scutum.	Shorter than scutum.
Pseudostigmata nearer posterior margin.	Nearer anterior margin.
Dorsal setae 2, 8, 6, plus a few posterior setae (rarely 2, 6, 8-10, 8).	2, 6, 6, 4, 2.
Seta on 2nd palpal segment plain.	Many branches.
3 palpal claws.	2 palpal claws.
No plain seta on tarsus iii.	Present.

It differs from *T. wichmanni* in the number and arrangement of the body-setae.

It is probably only a local variant, and it seems unnecessary to add another new name to the list, which might also include *T. pseudoakamushi* and *T. deliensis*. Confusion between these closely related species is not only possible, but probable, because it was apparently customary to dismiss them in a few lines until Gater published his detailed descriptions of the Malayan species in 1932. The increasing importance of certain species because of their association with endemic typhus makes more detailed descriptions essential.

Of approximately three thousand mites collected in the Bulolo basin, almost two thousand seven hundred are *T. hirsti* var. *buloloensis*. I have succeeded in hatching out twenty-one nymphs from these larvae, but as yet no adults. Detailed consideration of these does not come within the scope of the present work, but superficially they resemble Hirst's "*Neotrombicula autumnalis*".

TROMBICULA RIOI, n. sp. Figs. 4, 6, 7.

Body a short, wide, blunt oval, widest at the level of coxa iii, smoothly constricted midway. Striations strong; pitting on scutum, maxilla and coxae. Colour light orange. L, 316 μ ; W, 302 μ . Largest seen, 389 μ \times 375 μ . Maxillary setae curved, with long fine branches on the convex side. Chelicerae slender. Dorsal apical tooth single, small, blunt. Ventral tooth a small rounded swelling only. A long nude seta on each cheliceral sheath. Palpi rounded. One coarse straight seta on ii, with long branches on one side; one straight nude seta on iii; on iv, near the base, one long straight seta with fine branches on one side of the distal half, and two nude setae near the apex. Appendiculum small and rounded, with one short pointed nude seta near the base, and three fine setae with fine branches, near the apex. Palpal claw bifurcate, the dorsal element the longer; both elements slender, slightly curved, with sharp points, the central core orange. Scutum trapezoidal, only slightly wider posteriorly; almost twice as wide as long; L, 69 μ ; W, 120 μ . Anterior margin sinuate, the central third straight or slightly concave, the lateral thirds projecting forward; anterior corners rounded; lateral margins slightly concave; posterior margin concave in its middle third, convex in its lateral thirds, curving sharply forward in its lateral fifths to meet the lateral

margins; posterior corners rounded, set one-third of the distance forward. Scutal setae 5: with short coarse branches along the whole length of one side. Set in the corners, the three anterior in line. AM, 66μ ; AL, 68μ ; PL, 75μ . Pseudostigmata half-way back, behind and medial to the mid-point of the line joining the AM and PL setae; 50μ apart. Pseudostigmatic organs filiform, very slender, with a few fine branches on the distal third; L, 75μ . Ocular shield 6μ from the scutum. Eyes double, the anterior much the larger and more refractile, opposite the pseudostigmata; the posterior just behind the PL setae. Body setae 110; the first five rows of the dorsum are slightly curved, with a few short branches on the concave side and many slightly longer branches on the convex side. The first four rows of the venter are slightly curved, with short branches on both sides. The posterior setae, both dorsal and ventral, are more curved, and have longer branches than the others, set over the whole surface. Dorsum: Setae 68, in rows approximately as follows: 2, 14, 12, 4, 6, /8, 10, 8, 4. Venter: Setae 42, in rows approximately as follows: 2, 2, 8, 6, /10, 6, 4, 4. The last four rows of each surface are continuous, forming a series of concentric circles around the posterior pole of the body, composed of 18, 16, 12, and 8 setae respectively. Legs relatively long; i, 300μ ; ii, 230μ ; iii, 300μ . Leg setae long, slightly curved, with short fine branches on the convex side. Coxal setae single, and a single seta on each second segment. Base of sixth segment of each leg markedly constricted, and the distal part of the sixth segment of i markedly expanded. All tarsi tapering, the first more bluntly than the others. A short fine spur on tarsi i and ii, and a slender, not very conspicuous nude seta on iii. Several fine nude setae at the apex of each tarsus.

Eighteen specimens from 4 bush-fowl (*Megapodius duperreyi*).

Key to the Australian and New Guinea Species of Trombicula.

(Constructed by H. Womersley.)

1. Dorsal setae more than 50 2
Dorsal setae 42 or fewer 3
2. Dorsal setae arranged 2, 14, 12, 4, 6, 8, 10, 8, 4; the posterior rows set closely, their individual setae thicker and more strongly branched than the others. Scutum with posterior margin convex laterally, concave medially; AW, 118μ ; PW, 120μ ; L, 69μ *T. rioi*, n. sp.
Dorsal setae 2, 6, 8, and then about five rows of closely-placed setae branched similarly to the others. Scutum with posterior margin evenly convex; AW, 80μ ; PW, 86μ ; L, 51μ *T. macropus* Womersley 1936
3. Dorsal setae 42, arranged 2, 6, 6, 6, 6, 6, 4; $60-75\mu$ long. Scutum with posterior margin evenly convex; AW, 70μ ; PW, 70μ ; L, 101μ
..... *T. novae-hollandiae* Hirst 1929
Dorsal setae less than 42 4
4. Scutum with posterior margin convex laterally, strongly concave medially. Dorsal setae 24, arranged 2, 6, 6, 6(2), 2(6), 2 *T. wichmanni* Oudemans 1905
Scutum with posterior margin evenly convex 5
5. Dorsal setae 20, 40μ long, arranged 2, 6, 6, 2, 2, 2. Scutum, AW, 76μ ; PW, 94μ ; L, 56μ ; ratio PW/L, 1.68 *T. hirsti* Sambon 1927
Dorsal setae 20, 56μ long, arranged 2, 6, 6, 4, 2. Scutum, AW, 90μ ; PW, 110μ ; L, 66μ ; ratio PW/L, 1.66 *T. hirsti* var. *buloloensis*, n. var.
(The abbreviations AW and PW refer to the width of the scutum at the levels of the anterolateral and posterolateral setae respectively.)

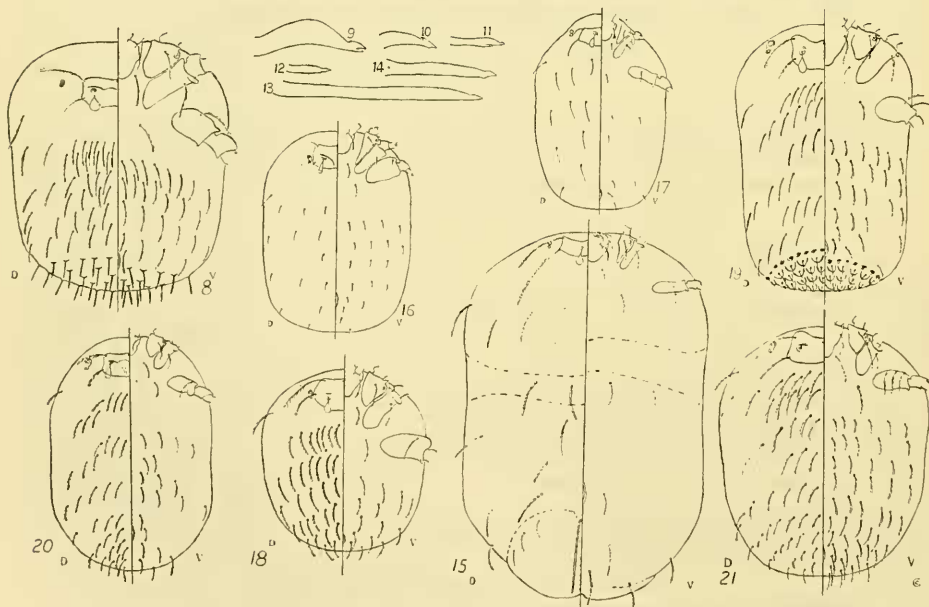
Genus NEOSCHÖNGASTIA Ewing 1929.

Manual External Parasites, 1929, 187.

NEOSCHÖNGASTIA YEOMANSI, n. sp. Figs. 8, 9, 22.

Body: Newly-hatched, a short broad oval, widest at level of coxa ii, rounded posteriorly; fully-grown, a broad sharply-tapering oval, widest at level of coxa ii.

Striations very fine, absent over the posterior fourth of the body; pitting on scutum, maxilla, and coxae, and over the posterior fourth of the body. Colour orange-red. Newly-hatched, L, 200 μ ; W, 167 μ ; largest seen, 333 μ \times 292 μ . Maxillary setae single, long, fine, with long fine branches on each side. Chelicerae stout, narrowed at the base, tapering to a sharp point. Dorsoapical tooth a short sharp barb well back from the apex; ventral tooth long and pointed, nearer to the apex than the dorsoapical. A long fine seta set with short fine spines on one side, on each cheliceral sheath. Palpi rounded. One long fine curved seta set with fine branches on the convex side, on ii; a similar seta on iii; on iv, near the base one seta with many fine branches on all sides, and near the apex one slender nude seta and one short stout seta. Appendiculum pointed, with six setae: one stout with many branches, four slender with fine branches, and one nude, near the base. Palpal claw trifurcate, with sharp points; the middle element the largest, the dorsal and ventral elements short and equal. Scutum oblong, twice as wide as long; L, 56 μ ; W, 100 μ . One-third of the distance back there is a transverse crest composed of four curved ridges, concave posteriorly, the lateral the strongest. Anterior to the crest the pitting is simple; posteriorly the pits are surrounded by circular striations. Anterior margin concave; anterior corners rounded and projecting forward; lateral margins slightly concave; posterior margin straight or slightly concave in the middle three-fifths, the lateral fifths curving forward to meet the lateral margins; posterior corners rounded, projecting slightly laterally. Scutal setae 5: fine, with fine branches over the whole length on all sides. The AM set back from the margin; the AL on the edge of the anterior corners, well in front of the AM; the PL set forward in the posterior corners. AM, 37.5 μ ;



Figs. 8-21.—S. Composite dorsal and ventral diagram of *Neoschöngastia yeomansi*, n. sp.; 9. Cheliceral fang of *N. yeomansi*, n. sp.; 10. Same of *N. kallipygos*; 11. *N. impar*, n. sp.; 12. *N. lorius*, n. sp.; 13. *N. edwardsi*, n. sp.; 14. *N. backhousei*, n. sp.; 15. Composite ventral and dorsal diagram of *N. kallipygos*; 16. Same of *N. impar*; 17. Same of *N. lorius*; 18. Same of *N. edwardsi*; 19. *N. retrocincta*, n. sp.; 20. *N. backhousei*; 21. *N. dubia*, n. sp.

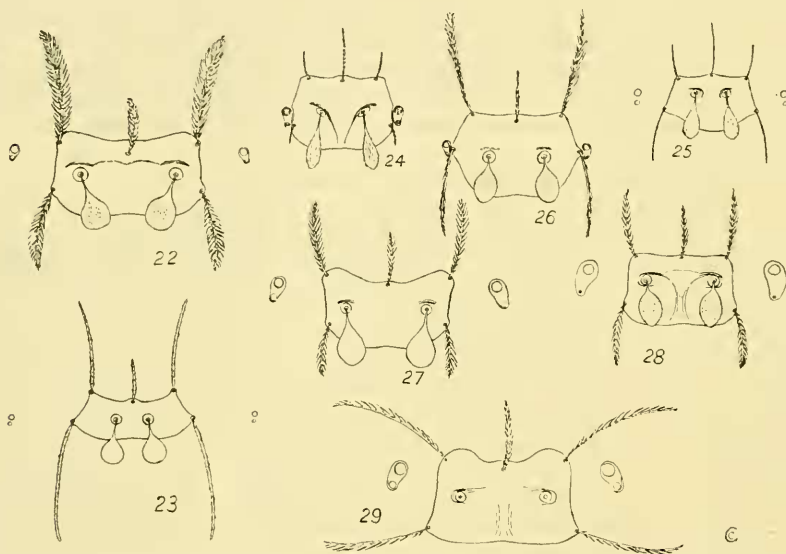
AL, 80 μ ; PL 60 μ . Pseudostigmata half-way back, lateral to the midpoint of the line joining the AM and PL setae; they are in the hollow behind the lateral curves of the crest, like eyes beneath eyebrows; 62.5 μ apart. Pseudostigmatic organs capitate, racquet-shaped. L, 37.5 μ ; stem, 9.5 μ ; head, 28 μ \times 19 μ . A few fine short setules on the head. Ocular shields 25 μ from the scutum. Eyes double, the anterior in line with the AM seta or just in front of it. In the newly-hatched larva they are close to the scutum, and relatively a little further back. Body setae approximately 178, of two forms: those on the anterior part fine, with fine branches; those on the posterior unstriated portion straight, stout and blunt, covered with minute short spines all over, and set on tubercles. The latter type comprise the last five rows on the dorsum, and the last four rows on the venter. Dorsum: setae 100, in rows approximately as follows: 2, 16, 8(10), 12(10), 10(8), 10, 8(10), /12, 6, 6, 6, 4. Venter: setae 78, in rows approximately as follows: 2, 2, 16, 14(12), 12, 6(8), 2, /10(8), 6, 4, 4. Legs relatively long; i, 260 μ ; ii, 215 μ ; iii, 270 μ . All leg setae fine with fine branches, except for a few on each tarsus which have a very few short branches. Coxal setae single. Sixth segment of each leg not markedly constricted, but that of iii slightly expanded distally. All tarsi tapering. A very slender spur on tarsus i; that on tarsus ii short and fine; a very fine long nude seta on iii.

Fifty specimens from ten bush-fowl (*Megapodius duperreyi*).

NEOSCHÖNGASTIA KALLIPYGOS, n. sp. Figs. 10, 15, 23.

Body a broad oval, widest at level of coxa iii. A slight shallow constriction midway, which marks a fold running obliquely around the body, dorsally at the level of the third row of setae, ventrally just behind coxa iii. A shallow cleft in the centre of the posterior margin, which marks the junction of two dorsal caudal swellings or plates, roughly semicircular in shape. The anus lies in a longitudinal fold on the ventral surface. No striations, but fine pitting over the whole surface, on the scutum, maxilla, and coxae. Colour pale dirty-yellow to pale orange. L, 487 μ ; W, 323 μ . Cephalothorax relatively small, set back on the ventral surface; only the tips of the chelicerae and palpi are visible from the dorsal aspect. Maxillary setae fine, with fine branches on the convex side. Chelicerae short, slightly curved. Dorsopical tooth single, a comparatively long barb; ventral tooth small. A long stout slightly curved nude seta on each cheliceral sheath. Palpi rounded. One short curved seta on ii, with fine branches on the convex side; a similar seta on iii; two fine long straight setae covered with short spines, on iv. Appendiculum pointed, with five or six setae; four or five very long, curved, and heavily branched on the convex side, set towards the apex; one short and straight, covered with fine spines, set towards the base. Palpal claw trifurcate, the ventral element the shortest, the dorsal the longest. Scutum trapezoidal, about two and one-half times as broad as long; L, 33 μ ; W, 81 μ . Set on the forward slope of the body. Anterior margin concave, sharply recurved around the AM seta; anterior corners projecting forward and laterally around the AL setae; lateral margins slightly concave; posterior margin convex, smoothly indented in the middle; posterior corners projecting backward and laterally around the PL setae. Scutal setae 5; long and stout, constricted at the base, tapering bluntly at the tip, covered with fine short spines over the whole surface. Set well into the projecting corners. AM, 28 μ ; AL, 63 μ ; PL, 83 μ . Pseudostigmata two-thirds of the way back, behind and medial to the midpoint of the line joining the AM and PL setae, 21 μ apart. Pseudostigmatic organs capitate, racquet-shaped, the stem very slender. L, 27.5 μ ; stem, 12.5 μ ; head, 15 μ \times 15 μ . Ocular shield absent. (Present in unhatched larva.)

Eyes double, opposite the centre of the scutum, nearer to the lateral margins of the body than to the scutum. (The two eyes are plainly visible in the unhatched larva, but only one can normally be made out with ease in the newly-hatched larva.) Body setae 46 to 50, of two forms: long and stout, narrow at the base, tapering bluntly at the tip, covered with short spines over the whole surface; and short and fine, curved, with fine branches on the convex side. The latter compose row 8 of the dorsum, and rows one to four of the venter. Dorsum: setae 28 (30 or 32) in rows as follows: 2, 6 (2 or 4), 4, 2, 4, 2, /6, /2. Row three varies; it is set on the transverse dorsal constriction; row seven is composed of two very long straight setae (L, 75μ) set close together; row eight is composed actually of two curved rows of three setae running more or less longitudinally along the lateral edges of the dorsal caudal plates; row nine is set on the posterior margin



Figs. 22-29.—Dorsal scutum of, 22. *N. yeomansi*; 23. *N. kallipygos*; 24. *N. impar*; 25. *N. lorius*; 26. *N. edwardsi*; 27. *N. retrocineta*; 28. *N. backhousei*; 29. *N. dubia*.

of the body, often more ventrally than dorsally. Venter: setae 18, in rows as follows: 2, 2, 4, 2, /4, 4. Legs relatively short. i. 180μ ; ii, 130μ ; iii, 205μ . Leg setae stout, straight, set with fine spines over the whole surface, except as below. Coxae set well in on the ventral surface, and well forward. Coxal setae single, curved, fine with fine branches on the convex side. A similar seta, but longer and coarser, on each second segment. Base of sixth segments not unduly constricted. Tarsus i truncated, the others tapering. Spur on tarsi i and ii short and fine; no spur on iii. Four curved branched setae at the apex of each tarsus. The central tarsal claw very long and fine, usually broken off.

Two specimens from an arboreal "mouse" (*Melomys* sp.), seven from two bandicoots (*Echymipera cockerelli* and *Peroryctes raffrayana*); many from Brown's rat (*Rattus browni*), Monckton's melomys (*Melomys moncktoni*), Stalker's melomys (*Melomys stalkerii*), the Rufous melomys (*Melomys ruber*), and the Brown bush-rat (*Rattus ringens*).

Many ova have been found cemented to the abdominal hairs of *Rattus ringens*, *Rattus browni*, and the various *Melomys*, containing *N. kallipygos* in recognizable stages of development. Detailed consideration of these does not come within the scope of the present work, but the fact throws light on the life-history of this species; it is obvious that adult females must spend at least some time as parasites on these hosts.

So far all attempts to hatch out nymphs with the technique used for *T. hirsti* var. *buloloensis* have failed.

It is probable that this larva should be placed in a separate genus, a subdivision of *Neoschöngastia*, on account of: The constricted body; the caudal plates; the shape of the scutum; the substitution of pitting for striations over the whole body-surface; the dorsal setae; the distinctive features of the tarsi; and the variation from the usual of the life-history.

NEOSCHÖNGASTIA IMPAR, n. sp. Figs. 11, 16, 24.

Body oval, widest at level of coxa iii, with a slight shallow constriction midway. Striations strong and very coarse; pitting on scutum, and finer and weaker on maxilla and coxae. Colour salmon-pink. L, 268 μ ; W, 196.5 μ ; largest seen, 333 μ \times 250 μ . Maxillary setae long, curved, with long fine branches on the convex side. Chelicerae stout, tapering sharply to a long slender tip. Dorsopical tooth single, small, blunt. Ventral tooth a small squared tubercle at the end of a ridge. A long straight slender nude seta on each cheliceral sheath. Palpi angular, with a small tubercle at the lateral angle of ii. One short slender nude seta on ii; a slender seta with two fine branches near its tip, on iii; on iv, two nude setae, one slender near the apex, the other short, stout and rod-like near the base. Appendiculum bluntly tapering, with four setae: one stout, with a few fine branches on both sides, three finer, with fine branches on the convex side only. Palpal claw bifurcate, the dorsal element stouter and more curved than, but equal in length to the ventral. Scutum a rounded oblong; L, 48 μ ; W, 66 μ . Anterior margin sinuate, with slight convexities in the middle and at each end; anterior corners rounded; lateral margins straight, but incavated opposite the ocular shields; posterior margin strongly convex, straight in its middle third; posterior corners rounded. Crest represented by two oblique ridges, concave posterolaterally, about one-third of the distance back. Scutal setae 5: short, stout, covered with a few short spines. The three anterior setae in the convexities of the anterior margin, the AM slightly behind the AL; the PL well forward in the posterior corners. AM, 37.5 μ ; AL, 19 μ ; PL, 12.5 μ . Pseudostigmata half-way back, in the hollows of the crest, medial to the mid-point of the line joining the AM and PL setae; 27 μ apart. Pseudostigmatic organs capitate, paddle-shaped, covered with short sharp setules. L, 37.5 μ ; stem, 7.5 μ ; head, 30 μ \times 9 μ . Ocular shields contiguous with the scutum. Eyes double, the anterior opposite the pseudostigmata. Underlying the anterior eye a group of four pale fluorescent bodies; beneath the posterior eye the number of these bodies varies from 0 to three. The posterior eye opposite the PL setae. Body setae 68 to 72; those of the dorsum short, pointed, with a few short spines; on the venter the first two rows are short, straight, with a few fine branches on one side; the remainder still shorter, with a few short spines. Dorsum: setae 26 to 30, in rows as follows: 2, 6, 6, (2), 6, 4, 2, (2). Rows 4 and 8 vary. Venter: setae 42, arranged in rows as follows: 2, 2, /8, 6, 8, 6, 4, 2, 2. Legs: there are only six segments in the mid and hind legs, due apparently to the fusion of the third and fourth segments; i, 150 μ ; ii, 130 μ ; iii, 163 μ . On legs i and ii the setae are short, with fine short branches on one

side; on iii they are longer, with fine long branches on one side. Coxal setae single. Sixth segment of i and fifth of ii and iii moderately constricted. Tarsus i is truncated, and bears a long nude seta with a tiny claw-like tip in addition to the usual stout spur. The other tarsi are tapered, ii bearing a stout spur, iii a long nude seta.

Sixty specimens from seven bandicoots (six *Echymipera cockerelli* and one *Peroryctes raffrayana*), many from two Monckton's melomys (*Melomys moncktoni*), one Stalker's melomys (*Melomys stalkerii*), one Rufous melomys (*Melomys rubex*) and thirteen Brown bush-rats (*Rattus ringens*).

The lack of a segment in the mid and hind legs, analogous to the similar condition in *Schöngastia oudemansi* Walch, does not warrant erecting a new genus. The fact is taken notice of in the name.

NEOSCHÖNGASTIA LORIUS, n. sp. Figs. 12, 17, 25.

Body a long ellipse, slightly produced anteriorly, with a shallow constriction behind the third coxa. Striations very fine; fine pitting on the scutum, and finer on maxilla and coxae. Colour bright orange-red. L, 259.5 μ ; W, 173.5 μ ; largest seen, 278 μ \times 200 μ . Maxillary setae fine, with three long fine branches. Chelicerae slender, sharp, tapering gently. Dorsopical tooth single, represented by a minute prominence. Ventral tooth a minute tubercle at the end of a ridge. A slender straight nude seta on each cheliceral sheath. Palpi rounded. One plain seta on each segment, that on iii the longest and most slender, that on iv shorter and very stout. Appendiculum short, bluntly tapering, with a rounded tip; bearing four plain setae, one very stout, two longer and more slender, and one stouter still, near the base. Palpal claw bifurcate, blunt, the two elements equal. Scutum roughly hexagonal, almost twice as broad as long; L, 37.5 μ ; W, 62.5 μ . Anterior margin projecting in the centre, the lateral portions slightly concave; anterior corners rounded; lateral margins straight; posterior margin strongly convex, bluntly pointed in the centre; posterior corners rounded. A small semicircular ridge around the anteromedial sides of the pseudostigmata. Scutal setae 5, slender, straight, covered with fine spines. The AM in the apex of the forward projection, in front of the AL, which are set well out in the anterior corners; the PL in the posterior corners. AM, 36 μ ; AL, 25 μ ; PL, 37.5 μ . Pseudostigmata one-third of the way back, medial to the midpoint of the line joining the AM and PL setae; 20 μ apart. Pseudostigmatic organs capitate, a broad paddle shape. L, 30 μ ; stem, 7 μ ; head, 23 μ \times 9.5 μ . Covered with fine short setules. Ocular shields apparently missing. Eyes double, about 19 μ from the scutum, the anterior opposite the pseudostigmata. Body setae 42, stout, almost straight, covered with fine spines. Dorsum: setae 22, in rows as follows: 2, 6, 6, 4, 2, 2. Venter: setae 20, in rows as follows: 2, 2, 4, 2, 4, 4, 2. Row 1 is close behind the maxilla, anterior to the tips of the first coxae. Legs: i, 134 μ ; ii, 92 μ ; iii, 130 μ . Leg setae nude except as follows: on the second segment, a prominent seta with a few very short branches along the convex side; the setae on the sixth and seventh segments similar but shorter. Coxal setae single; the first with 3 fine long branches, the others nude. Tarsus ii tapering very bluntly, iii very long and slender. A short blunt spur on tarsi i and ii, a long slender nude seta on iii. The central tarsal claw very long and slender.

Twelve specimens from a parrot (*Lorius roratus* subsp.).

NEOSCHÖNGASTIA EDWARDSI, n. sp. Figs. 13, 18, 26.

Body rounded, widest at level of coxa iii, slightly flattened posteriorly. Striations very coarse and strong; pitting on scutum, maxilla and coxae. Colour

orange. Newly-hatched, L, 187.5 μ ; W, 169 μ ; half-grown, L, 244 μ ; W, 213 μ ; no fully-engorged specimens were taken; largest seen, 278 μ \times 250 μ . Maxillary setae long and fine, with a few fine branches on the convex side of the proximal half. Chelicerae very long, straight and slender. Dorsal tooth a small sharp barb. Ventral tooth apparently missing. A long fine straight nude seta on each cheliceral sheath. Palpi slender and curved. A fine seta with many long fine branches on ii; one with short fine branches on iii; on iv one at the base with fine branches, and two nude at the apex. Appendiculum with eight setae: seven with fine branches, and one nude near the base. Palpal claw bifurcate, the ventral element the longer, both slender, blunt and slightly curved. Scutum roughly hexagonal, half as broad again as long; L, 56 μ ; W, 87.5 μ . Anterior margin slightly concave, slightly recurved in the middle; anterior corners angular; lateral margins straight; posterior margin strongly convex, the middle fifth concave; posterior corners sharp and projecting. A slight, gently-curved ridge in front of each pseudostigma. Scutal setae 5: relatively very long, with many long branches on all surfaces. Set well into the angles, the AL just in front of the AM. AM, 37.5 μ ; AL, 75 μ ; PL, 60 μ . Pseudostigmata half-way back, just behind the PL setae; 36 μ apart. Pseudostigmatic organs capitate, leaf-shaped, covered with minute setules. L, 29 μ ; stem, 6 μ ; head, 23 μ \times 15 μ . Ocular shield contiguous with the scutum, curved around the posterior corners. Eyes double, the anterior the larger, in front of the PL setae; the posterior behind the PL setae. Body setae 96, with closely-set short branches on the convex side, those of the venter finer than the dorsal. Dorsum: setae 64, in rows as follows: 2, 14, 14, 10, 12, 8, 4. Venter: setae 32, in rows as follows: 2, 2, 8, 4, 6, 6, 4. Row one on one specimen has three setae. Row six sometimes contains eight setae. Legs relatively long. i, 210 μ ; ii, 200 μ ; iii, 230 μ . Leg setae with fine branches on the convex side; a few straight setae with a few short apical branches on each tarsus. Coxal setae single, slender, with fine branches on the convex side. The sixth segment of each leg is expanded distally, that of leg iii less than the others. Tarsi tapering. A short slender nude seta on tarsus i instead of the usual spur; a short stout spur on ii; a long slender nude seta on iii.

Twenty specimens from five bush-fowl (*Megapodius duperreyi*); one from a bandicoot (*Echymipera cockerelli*).

NEOSCHÖNGASTIA RETROCINCTA, n. sp. Figs. 19, 27.

Body rounded anteriorly, flatly convex posteriorly, slightly convex laterally, widest opposite coxa iii. Striations moderately strong, merging into pitting over the posterior fourth of the body. Pitting also on scutum, maxilla and coxae. A circle of thirty small tubercles, devoid of setae, surrounding the body at the level of the posterior margin of the anus. Within this circle, twenty-two to twenty-five closely-set large tubercles bearing setae. Colour yellow. L, 354 μ ; W, 236 μ . Maxillary setae long, with fine branches on the convex side. Chelicerae missing from both specimens. A short seta, apparently nude, on each cheliceral sheath. Palpi rounded, narrow at the base, widest at the apex of ii. One long seta, with long fine branches on the convex side, on ii; one with short branches on the convex side on iii; on iv one short stout blunt nude seta near the base, and one with short branches on the convex side, near the apex. Palpal claw trifurcate, the middle element the longest, the ventral the shortest. Appendiculum with 5 or 6 branched setae, one stout and prominent. Scutum roughly crescentic; L, 52 μ ; W, 87 μ . Anterior margin strongly concave, recurved in the middle; anterior corners rounded, large, projecting forward; lateral margins slightly

concave; posterior margin convex, indented in the middle, not clearly defined, but merging into the body-striations; posterior corners rounded. Short curved ridges in front of the pseudostigmata, and a diffuse longitudinal swelling down the centre. Simple pits in front of the crest; behind it, the pits surrounded by circular striations. Scutal setae 5, long, with long branches over all surfaces; set into the angles, the AM well behind the AL. AM, 37.5 μ ; AL, 56 μ ; PL, 47 μ . Pseudostigmata half-way back, lateral to the midpoint of the line joining the AM and PL setae; behind the ridges of the crest; 53 μ apart. Pseudostigmatic organs capitate, racquet-shaped, with no apparent setules, but striated. L, 37.5 μ ; stem, 9.5 μ ; head, 28 μ \times 19 μ . Ocular shield 25 μ from scutum. Eyes double, the anterior opposite the AM seta. Body setae 104 (106), plus 22 to 25 caudal setae. Those of the dorsum long, with short branches on the convex side; the first two ventral rows long, with long branches on the convex side, the remainder on the venter similar but shorter; the caudal setae stout, straight, nude. Dorsum: setae 52, in rows as follows: 2, 8(10), 12(10), 6, 8(10), 8, / 8(6), / 17 tubercles, / plus 11(13). Row seven is on the part where the striations have given way to pitting. Venter: setae 52(54), in rows as follows: 2, 2, 10(12), 12(10), 10, 8, / 4(6), 6(2), / 13 tubercles, / plus 11(12). Rows seven and eight are on the pitted part, row seven anterior to, row eight level with the anus. Legs relatively long; i, 245 μ ; ii, 207 μ ; iii, 240 μ . Leg setae vary; they have branches on the convex side except as follows: on the third to sixth segment of i, third to fifth segment of ii, and on the third segment of iii, they have branches on all sides. Coxal setae very long, with fine branches on the convex side; a single seta on coxae i and ii, but two on iii. The base of the sixth segment is constricted, its distal portion expanded, on each leg. A long fine spur on tarsus i, a shorter fine one on ii, a long nude seta on iii.

Two specimens from a bush-fowl (*Megapodius duperreyi*).

In the absence of chelicerae from both specimens, the justification for placing this species in the genus *Neoschöngastia* rests on the fact that the scutal crest resembles the crests of the other species of *Neoschöngastia* here described. The appearance of circular striations around the pits on the portion of the scutum behind the crest resembles that of *N. yeomansi* and *N. backhousei*; and partly on the evidence of eyes and palpal claws.

Ewing's key (1929) reads, in part,

- "4. Chelicerae armed with a row of teeth above; palpal claw usually bifurcate
 *Schöngastia* Oudemans
 Chelicerae each with not more than a single dorsal tooth; palpal claw trifurcate
 *Neoschöngastia* (new)"

to which Womersley (1937) adds, for *Neoschöngastia*, "Eyes two"; a previous division of his key indicates that *Schöngastia*, among other genera, is characterized by single eyes.

That is, besides the evidence afforded by the cheliceral teeth, *Schöngastia* has single eyes and usually bifurcate palpal claws; *Neoschöngastia* double eyes and trifurcate claws; the latter is the case in this species.

N. retrocineta is a member of a group, the outstanding example of which is *N. yeomansi*, which contains also *N. backhousei* and *N. dubia*. The features of this group are: Well-defined crest on scutum; typical scutal pitting, with the pits behind the crest surrounded by circular striations; pitting, not striations, on the posterior portion of the body; distinctive setae on the pitted portion. It is possible that this group may be found to constitute a new genus, a second subdivision of *Neoschöngastia*.

N. retrocineta is also linked with *N. dubia*, in that each has multiple setae on the third coxa. *N. mutabilis* Gater, 1932, also shows this feature; the number varies from three to five, and also varies on each side of the same specimen.

NEOSCHÖNGASTIA BACKHOUSEI, n. sp. Figs. 14, 20, 28.

Body oval, widest at level of coxa iii. Striations fine and moderately strong, but weaker over the posterior sixth of the body; pitting on scutum, maxilla and coxae, and over the posterior sixth of the body. Colour orange. L, 312 μ ; W, 216 μ . Maxillary setae single, long, fine, with a few long branches on all sides. Chelicerae straight, slender, tapering to a sharp point. Dorsopical tooth represented by a minute subterminal tubercle. Ventral tooth a minute pointed swelling. A slender straight nude seta on each cheliceral sheath. Palpi rounded. A long seta with a few long branches on the convex side on ii; a shorter seta with a few long branches on the convex side on iii; on iv, at the base, a short seta with a few long branches on the convex side, and two nude setae at the apex. Palpal claw trifurcate, sharp, the middle element the longest, the dorsal and ventral elements equal in length. Appendiculum rounded, with four or five setae, one nude, the others stout with short branches. Scutum a rounded trapezoid, half as wide again as long, with a crest one-third of the distance back, consisting of two short lateral curves joined by a weaker long central curve, all concave behind; from the centre of the crest a diffuse ridge runs back to the posterior margin. The pits in front of the crest simple; behind the crest they are surrounded by circular striations. Anterior margin sinuate, with three smooth convexities; anterior corners rounded; lateral margins slightly concave; posterior margin convex; posterior corners rounded. L, 47 μ ; W, 75 μ . Scutal setae 5, long, with fine branches on all sides. The three anterior in line, in the anterior convexities; the PL forward in the posterior corners, on the margins of the scutum. AM, 37.5 μ ; AL, 47 μ ; PL, 44 μ . Pseudostigmata about two-fifths of the way back, behind the lateral curves of the crest, lateral to the midpoint of the line joining the AM and PL setae; 44.5 μ apart. Pseudostigmatic organs capitate, a broad leaf-shape, the apex bluntly pointed, the head covered with fine setules. L, 30 μ ; stem, 6 μ ; head, 24 μ \times 15 μ . Ocular shield 19 μ from the scutum. Eyes double, the anterior just in front of the pseudostigmata. Body setae 116, of three forms: the first four rows of the dorsum with short branches all over; the remainder of the dorsum and the last two rows of the venter with very short branches on the convex side, a few short spines on the concave side; the remainder of the venter with short branches on the convex side only. Dorsum: setae 72, in rows approximately as follows: 2, 14, 14, 10, / 8, 8, 6, 6, 2, 2. Venter: setae 44, in rows approximately as follows: 2, 2, 8, 4, 6, 8, 2, 2, / 6, 4. Legs relatively long; i, 190 μ ; ii, 125 μ ; iii, 167 μ . Coxal setae single, the first two with short branches all over, the third with branches on the convex side only. On the second to the fourth segments of i and ii the setae have short branches all over; on the last three segments of these legs, and on all the segments of iii, they have branches on the convex side only. Tarsus i has a sharp concave taper dorsally, with the dorsal nude seta very prominent and set on a tubercle, the spur very short and fine. The spur on tarsus ii is short, stout and blunt; there are two prominent setae set with short spines. There is no prominent nude seta on tarsus iii.

Two specimens from two bush-fowl (*Megapodius duperryi*).

NEOSCHÖNGASTIA DUBIA, n. sp. Figs. 21, 29.

Body a blunt oval, widest at level of coxa iii. Striations fine and strong; pitting on scutum, maxilla and coxae. Colour orange. L, 333 μ ; W, 278 μ . Maxillary

setae long, with many branches on the convex side. Chelicerae missing. A short fine seta with three very fine branches on each cheliceral sheath. Palpi stout, rounded. A very long seta with fine branches on the convex side on ii; a long seta with four branches on the convex side on iii; on iv, near the base, a stout seta with fine branches on one side, and near the apex two nude setae, one slender, the other stout. Palpal claw trifurcate, the middle element much the longest, the dorsal and ventral elements equal, all with sharp points. Appendiculum rounded, with six setae: four very long, one of them coarse and heavily branched, the other three finer, with fine branches on the convex side; two nude, one slender, the other stout. Scutum: L, 62.5 μ ; W, 100 μ . Anterior margin strongly concave; anterior corners rounded, projecting well forward; lateral margins straight; posterior margin convex, indented in the middle; posterior corners small, projecting laterally. In front of each pseudostigma a short flatly-curved ridge, about one-third of the distance back. A longitudinal diffuse ridge along the posterior two-thirds of the midline. Pits simple in front of the crest; those behind it surrounded by circular striations. Scutal setae 5, very long, the AM with branches over all surfaces, set well back from the anterior margin; the others with fine branches on the convex side only, the AL on the lateral margins of the anterior corners, the PL in the posterior corners. AM, 47 μ ; AL, 84.5 μ ; PL, 75 μ . Pseudostigmata half-way back, behind the ridges of the crest, lateral to the mid-point of the line joining the AM and PL setae; 56 μ apart. Pseudostigmatic organs missing. Ocular shield 19 μ from scutum. Eyes double, the anterior opposite the AM setae. Body setae 196, with branches on the convex side only. On the dorsum the anterior setae are very long; they become successively shorter, with fewer and shorter branches, towards the posterior pole. On the venter, rows one and two are long, row three is very short. They become successively longer towards the posterior pole, with fewer and shorter branches. Dorsum: setae 96, in rows approximately as follows: 2, 14, 10, 12, 6, 14, 14, 12, 8, 4. Venter: setae 100, in rows approximately as follows: 2, 2, /12, 10, 10, 10, 12, 12, 10, 8, 6, 4, 2. Legs relatively long; i, 278 μ ; ii, 230 μ ; iii, 292 μ . A single seta, with short branches all along one side, on coxae i and ii; three setae with only a few short branches on one side of the distal third, in a row along the anterior margins of coxa iii. On the second segment of each leg a long seta with long branches all over. The other setae have branches on the convex side only, those on the distal segments with fewer and shorter branches. The spurs on tarsi i and ii long and stout, the dorsal nude seta on tarsus i prominent. A very long slender nude seta on tarsus iii.

One specimen, imperfect, from a bush-fowl (*Megapodius duperreyi*).

In the absence of both chelicerae and pseudostigmatic organs, the placing of this species in the genus *Neoschöngastia* is certainly speculative. Nevertheless the scutal crest and scutal pitting resemble those of certain other species of this genus here described, and the evidence of trifurcate palpal claws and double eyes is of value (see discussion on *N. retrocincta*). The presence of three setae on coxa iii is analogous to the similar condition in *N. retrocincta*, and *N. mutabilis* Gater 1932.

Key to the Australian and New Guinea Species of Neoschöngastia.

(After Womersley.)

1. Scutum with a well-defined crest, often in four curves; the pseudostigmata in the posterior walls of the crest. Anterior part of scutum with pits only, posterior part with circular striations surrounding pits. Body striated anteriorly, pitted posteriorly. Dorsal setae 64 μ to 100 μ *geomansi* group 2
- Scutum without definite crest, but with a line round the pseudostigmata; simply pitted, without striations. Body either entirely striated or entirely pitted. Dorsal setae 22 to 64 5

2. Coxa iii with a single seta 3
 Coxa iii with more than one seta 4
3. No striations over posterior fourth of body, but pitting over this area. Setae in this area arising from tubercles. Dorsal setae 100, arranged 2, 16, 8(10), 12(10), 10(8), 10, 8(10), 12, 6, 6, 6, 4 *N. yeomansi*, n. sp.
 Striations weak over posterior sixth of body, with weak pitting over this area. Dorsal setae 72, arranged 2, 14, 14, 10, 8, 8, 6, 6, 2, 2 *N. backhousei*, n. sp.
4. Coxa iii with two setae. Posterior pitted area of body relatively small, bounded anteriorly by a circle of tubercles devoid of setae; setae in this area arising from tubercles. Dorsal setae 64, arranged 2, 8(10), 12(10), 6, 8(10), 8, 8(6), tubercles, 12 *N. retrocineta*, n. sp.
 Coxa iii with three setae. No pitted area posteriorly on body. Dorsal setae 96, arranged 2, 14, 10, 12, 6, 14, 14, 12, 8, 4 *N. dubia*, n. sp.
5. Body pitted all over, not striated; strongly constricted at level of coxa iii; with two semicircular caudal plates, each bearing three fine setae. Dorsal setae 28 to 32 *N. kallipygos*, n. sp.
 Body striated all over, not pitted; of usual shape, or only slightly constricted at coxa iii. No caudal plates 6
6. Pseudostigmatic organs more or less globular 7
 Pseudostigmatic organs definitely clavate 11
7. Posterior margin of scutum convex, so that the postero-lateral setae are much in advance of its midpoint 8
 Posterior margin of scutum straight or sinuate, so that the posterolateral setae are hardly, if at all, in advance of its midpoint 10
8. Pseudostigmatic organs a broad leaf-shape. Scutum roughly hexagonal; corners angular; posterior margin strongly convex, its lateral thirds at about 45° from the middle third. Pseudostigmata almost in line with the posterolateral setae. Dorsal setae 64, 26 μ long, arranged 2, 14, 14, 10, 12, 8, 4 *N. edwardsi*, n. sp.
 Pseudostigmatic organs truly globular. Scutum roughly trapezoidal, corners rounded 9
9. Posterior margin of scutum rounded. Dorsal setae 32, 50 μ long, arranged 2, 6, 6, 6, 6, 4, 2 *N. coorongense* Hirst 1929
 Posterior margin of scutum flattened medially. Dorsal setae approximately 64, 40 μ long, arranged 2, 6, 6, then about 50 in five or six rows *N. petrogale* Womersley 1934
10. Anterior margin of scutum four-fifths of length of posterior margin. Dorsal setae 50, 36 μ long, arranged 6, 8, 8, 8, 8, 6, 4, 2 *N. antipodianum* Hirst 1929.
11. Scutum three-fourths as long as wide 12
 Scutum three-fifths, or less, as long as wide 13
12. Posterior margin of scutum evenly convex. Pseudostigmata in line with postero-lateral setae. Dorsal setae 32, 40 μ long, arranged 2, 8, 6, 6, 6, 2, 2 *N. dasyceci* Hirst 1929
 Posterior margin of scutum flattened in its middle third. Pseudostigmata well in front of posterolateral setae. Only six segments in mid- and hind-legs. Dorsal setae 26 to 30, 26 μ long, arranged 2, 6, 6, (2), 6, 4, 2, (2) *N. impar*, n. sp.
13. Scutum three-fifths as long as wide; roughly hexagonal; posterior margin strongly convex, bluntly pointed in the centre; anterior margin projecting in the centre. Pseudostigmata closer to the anterolateral setae than to the posterolaterals. Dorsal setae 22, 30 μ long, arranged 2, 6, 6, 4, 2, 2 *N. lorius*, n. sp.
 Scutum not more than half as long as wide; posterior margin concave. Dorsal setae 34, 79 μ long, arranged 2, 8, 6, 6, 6(4), 4(6), 2 *N. westraliense* Womersley 1934

Genus SCHÖNGASTIA Oudemans, 1910.

Entomol. Ber., iii, No. 54, 1910, 86.

SCHÖNGASTIA JAMESI, n. sp. Figs. 30, 33, 36.

Body a rounded oval, flattened anteriorly, widest at level of coxa iii. Striations coarse and moderately strong; very fine pitting on scutum, maxilla and coxae, and over the anterior third of the venter. Colour bright orange. L, 278 μ ; W, 232 μ . Maxillary setae single, fine, with six long branches on the convex side. Chelicerae very long, straight, slender; a minute sharp dorsoapical barb, with ten

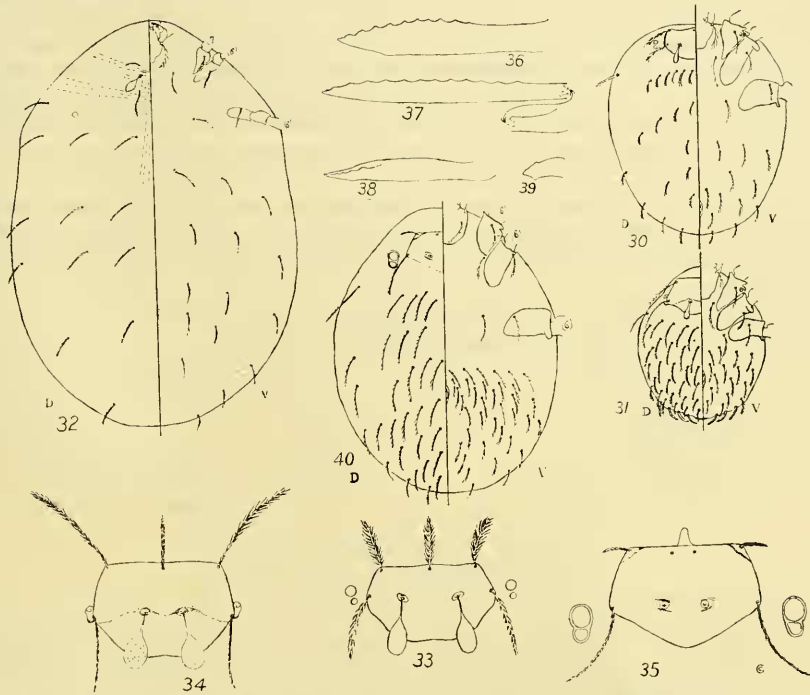
small saw-teeth in a row on the distal two-thirds. Ventral tooth represented by a rounded thickening opposite the fourth and fifth teeth. Cheliceral sheaths long, slender, reaching almost to the ends of the chelicerae, and bearing a short nude curved seta on the base of each. Palpi rounded, slender, narrow at the base, widest towards the distal end of ii. A long seta with long branches all over on ii; a short seta with a few long branches on iii; on iv a long seta near the base with six branches on the convex side, two short nude setae near the apex. Palpal claw trifurcate, the dorsal and ventral elements long and sharp, with a shorter, finer lateral element alongside them. Appendiculum with a rounded point, bearing seven setae; one prominent, four finer, all with branches along one side; two nude, the one stout, short and curved, the other fine and straight. Scutum a rounded trapezoid. L, 50μ ; W, 85μ . Anterior margin sinuate; anterior corners rounded; lateral margins slightly concave; posterior margin convex; posterior corners rounded. Scutal setae 5, long, with long branches on all sides. The three anterior in line; the PL in the posterior corners on the margins of the scutum. The AM broken off short; AL, 37.5μ ; PL, 47μ . Pseudostigmata just behind the PL setae; 37μ apart. Pseudostigmatic organs capitate, leaf-shaped, with apparently no setules on the head. L, 37.5μ ; stem, 12.5μ ; head, $25\mu \times 12.5\mu$. Ocular shield 7μ from scutum. Eyes double, the anterior just in front of the PL setae. Body setae approximately 68. (The dorsal details cannot be made out easily, as the only available specimens are not well cleared and are all mounted with the dorsum down. The figures are therefore imperfect.) Those of the first dorsal row are stout, straight, blunt, with a few short spines along one side; those of the first two ventral rows are slender, with long branches on one side; the remainder, dorsal and ventral, have short branches on one side. Dorsum: setae approximately 40, in rows as follows: 2, / 12, (8), (4), (6), 4, 2, 2. Venter: setae 28, in rows as follows: 2, 2, / 6, 4, 8, 4, 2. Legs relatively very long. i, 246μ ; ii, 209μ ; iii, 215μ . Coxal setae single, long, with many branches on the convex side. The leg setae similar, but those on the distal segments have fewer branches, those of iii having shorter and still fewer branches. The bases of the sixth segments are markedly constricted, their distal portions markedly expanded. All tarsi tapering, the third very long. A fine spur on tarsus i; that on ii short and blunt; a fine nude seta, not at all prominent, on iii.

Two specimens from a bush-fowl (*Megapodius duperreyi*); one from a bandicoot (*Echymipera cockerelli*).

SCHÖNGASTIA BLESTOWEI, n. sp. Figs. 31, 34, 37.

Body a short rounded oval, widest at level of coxa iii. Striations moderately coarse, strong and very wavy; pitting on scutum, maxilla and coxae. Colour dull brownish-orange. Newly hatched, L, 167μ ; W, 167μ ; average, $203\mu \times 168\mu$; largest seen, $223\mu \times 207\mu$. Maxillary setae single, short, stout, with four long branches on the convex side. Maxilla typically square. Chelicerae very long, straight, slender, with sharp points. A minute dorso-apical barb and a row of twelve denticles along the distal three-fifths. Ventral tooth apparently missing. Cheliceral sheaths slender, as long as the chelicerae, with a long nude seta on the base of each. Palpi rounded, projecting boldly forward. A long seta with a few fine branches on the convex side on ii; a similar seta, but shorter on iii; on iv near the base a short seta with a very few fine branches on the convex side, near the apex two nude setae, one very short and stout. Palpal claw trifurcate, the ventral element much the longest and stoutest, the lateral very short and fine, almost vestigial. Appendiculum rounded, with six setae; one

stout with a few stout branches, three finer with short fine branches, and two nude, one of them short, sharp and strongly curved. Scutum rounded, straight anteriorly. L, 62.5μ ; W, 94μ . Crest a sinuate overhanging ledge, two-thirds of the way back; the posterior portion of the scutum at a much lower level than



Figs. 30-40.—30. Composite dorsal and ventral diagram of *Schöngastia jamesi*, n. sp.; 31. Same of *S. blestowci*, n. sp.; 32. *Walchia morobensis*, n. sp.; 33. Dorsal scutum of *S. jamesi*; 34. Same of *S. blestowci*; 35. *Leeuwenhoekia australiense* Hirst; 36. Cheliceral fang of *S. jamesi*; 37. Same of *S. blestowci*; 38. Same of *L. australiense*; 39. Same of *W. morobensis*; 40. Composite dorsal and ventral diagram of *L. australiense*.

the anterior. Crest very faintly marked in some specimens. Anterior margin straight; anterior corners angular, projecting very slightly forward; lateral margins slightly convex; posterior margin strongly convex, with a smooth indentation in the middle; posterior corners about two-thirds of the way back, angular, projecting laterally. Scutal setae 5, the AM 37.5μ , stouter than the others, with short branches on all sides, set well back from the anterior margin, behind the AL; the AL 75μ , slender, with long branches on all sides, well forward in the anterior corners; the PL 50μ , slender, with branches on one side only, in the posterior corners. Pseudostigmata half-way back, directed almost horizontally, lying under the overhang of the crest, just anterior to the PL setae; 25μ apart. Pseudostigmatic organs capitate, racquet-shaped, the heads covered with fine short setules. L, 37μ ; stem, 12μ ; head, $25\mu \times 15\mu$. Ocular shield applied to the scutum from well in front of the pseudostigmata to behind the PL setae. Eyes single, small, the posterior missing; just anterior to the pseudostigmata. Body setae 108, of three forms: those of the last two rows of both

dorsum and venter are short, stout, curved, with short spines along the convex side; the remainder of the dorsum stout, with closely-set branches on the convex side; the remainder of the venter slender, with a few branches on the convex side. Dorsum: setae 64, in rows as follows: 2, 10, 8, 10, 8(10), 10(8), / 8, 8. Row eight is on the posterior margin, often more ventral than dorsal. Venter: setae 44, in rows as follows: 2, 2, 10(8), 8(10), 6, 6, / 6, 4. Row six is at the level of the anus. Legs relatively very long; i, 270 μ ; ii, 209 μ ; iii, 250 μ . Leg setae slender, with a few fine branches on the convex side. Coxal setae single. Sixth segments not unduly constricted or expanded. Tarsi tapering. A short stout spur on tarsus i, the dorsal nude seta prominent, set on a tubercle. The spur on tarsus ii short, finer and sharper. A very fine nude seta on tarsus iii, often broken.

Fifteen specimens collected from two men near the Suein River, Sepik District; eight specimens from abandoned colonies in the ears of two bush-fowl (*Megapodius duperreyi*) from the Bulolo River basin, Morobe District; six specimens from a man at Bulolo.

There is a strong resemblance between this species and *S. vandersandei* Oudemans, 1905. The differences are as follows:

<i>S. vandersandei</i>	<i>S. blestowei</i>
Dorsal setae 50.	64.
Ventral setae 42.	44.
Dorsal setae arranged:	
2, 10, 10, 10, 10, 8.	2, 10, 8, 10, 8(10), (10)8, 8, 8.
2 palpal claws.	3.
Maxillary setae plain.	With 4 long branches.

Key to the New Guinea Species of Schöngastia.

(Constructed by Mr. H. Womersley.)

- Dorsal setae more than 50 2
- Dorsal setae 40, arranged 2, 12, (8), (4), (6), 4, 2, 2. 50 μ long *S. jamcsi*, n. sp.
- Dorsal setae 52, arranged 2, 10, 10, 10, 10, 8(10), 2(10). Ventral setae 42. Maxillary setae plain. Palpal claw bifurcate *S. vandersandei* Oudemans 1905
- Dorsal setae 64, arranged 2, 10, 8, 10, 8(10), 10(8), 8, 8. 40 μ long. Ventral setae 44. Maxillary setae with four long branches. Palpal claw trifurcate *S. blestowei*, n. sp.

Genus *WALCHIA* Ewing.

Proc. U.S. Nat. Mus., lxxx, 1931, 10.

WALCHIA MOROBENSIS, n. sp. Figs. 32, 39.

Body a broad oval, widest midway, the anterior fourth with a gradual straight taper to a rounded point. Irregular folds radiating in all directions from behind the pseudostigmata. No striations; pitting all over, not specially marked on scutum, maxilla or coxae. Cephalothorax completely hidden below the anterior point of the body. Colour a dirty cream. L, 425 μ ; W, 310 μ ; largest seen, 535 μ \times 375 μ . Maxillary setae single, long, fine, curved, with long fine branches on the convex side. Chelicerae short, stout, almost straight, tapering very sharply. Dorso-apical tooth single, small, sharp. Ventral tooth a small swelling behind a shallow notch. Cheliceral sheath almost as long as the chelicerae, and relatively stout. Palpi small, strongly curved, ii angular. A long nude seta on ii; a similar one on iii; on iv two short nude setae and a longer one with a few fine short branches. Palpal claw bifurcate, the two elements curved, very long and slender, the ventral slightly longer and stouter than the dorsal. Appendiculum small, rounded, with five setae; two long and stout,

with a few fine branches; two long and very fine, with a few fine short branches; and one short, nude, stout and pointed. Scutum not distinguishable in these specimens. Pseudostigmata 53μ back from the anterior margin of the body (74μ in the largest specimen) and 25μ apart (this figure does not vary). An oblique curved ridge lies around the anterior and medial aspects of each pseudostigma. Scutal setae 4: a pair 14μ in front of the pseudostigmata, 18μ long, curved, with two or three fine branches; and a pair 19μ behind the pseudostigmata, 30μ long, curved, with five or six long fine branches. Pseudostigmatic organs capitate, leaf-shaped, the head covered with setules. L, 25μ ; stem, 6μ ; head, $19\mu \times 11\mu$. Ocular shield apparently missing. Eyes single, very indistinct except in freshly-killed specimens; about 75μ lateral to and 30μ behind the corresponding pseudostigma. Body setae 58, those of the dorsum and the first two rows of the venter long, fine, with six to eight long fine branches on the convex side; the remainder of the venter shorter, with fewer branches. Dorsum: setae 26, in rows as follows: 2, 6, 6, 6, 4, 2. Venter: setae 32, in rows as follows: 2, 2, 8, 6, 6, 6, 2. Row five is level with the anus. Legs relatively very short; i, 125μ ; ii, 111μ ; iii, 165μ . Only six segments in legs ii and iii. Leg setae long, fine, with a few fine branches along the convex side. Coxal setae single. The sixth segment of i and the fifth of ii short and stout; the fifth of iii is of typical shape. Tarsi bluntly tapered, short. The dorsal nude seta on tarsus i prominent, the spur very long, stout and curved; the spur on ii shorter but stouter. No prominent nude seta on iii. On each tarsus two or three setae with only two fine terminal branches.

Four specimens from two Brown's rats (*Rattus browni*); many from the Brown bush-rat (*Rattus ringens*).

Genus LEEUWENHOEKIA Oudemans, 1911.

's Gravenhage Ber. Ned. Ent. Ver., iii, 1911, 138.

LEEUWENHOEKIA AUSTRALIENSE Hirst. Figs. 35, 38, 40.

Trans. Roy. Soc. Trop. Med. Hyg., xix, 1925, 150.

A single specimen of this species, lacking the pseudostigmatic organs, was taken at Bulolo from a Cassowary (*Casuarus casuarius*). I am indebted to Mr. H. Womersley for its identification.

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